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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/530,588	05/05/2000	KIMIHIRO MATSUSE	2312-0866-2P	6686

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EXAMINER

QUACH, TUAN N

ART UNIT	PAPER NUMBER
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2814

DATE MAILED: 01/29/2003

Please find below and/or attached an Office communication concerning this application or proceeding.)

Office Action Summary

Application No.

09/530,588

Applicant(s)

MATSUSE ET AL.

Examiner

Tuan Quach

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 04 November 2002.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 89-111 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 89-111 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☒ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____

- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

The objection of the declaration as delineated in Paper No. 18 remain applicable in view of the newly presented claims 89-111 and subject matter regarding the numerous newly added limitations therein. Note that the supplemental declaration filed November 4, 2002 is unacceptable as it fails to identify or acknowledge the amendment filed therewith regarding the subject matter claimed in claims 89-111.

Claims 89-111 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

There is no support for the "carrying the substrate on which the first metal layer and one of the second metal layer and the insulating layer are formed, into a processing apparatus" as now claimed in claims 89 and 107 first step. There is further no support for forming the barrier between two metals.

Claims 89-111 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. There is no enablement for forming the nitride barrier between the first and second metal layers or between the first metal and an insulating layer by the process delineated in claim 89 and 107 consistent with the first step delineated above.

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The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

For convenience, "et al." in a reference is omitted, e.g., Park for Park et al.

Claims 107-111 insofar as in compliance with 35 U.S.C. 112, are rejected under 35 U.S.C. 103(a) as being unpatentable over Meikle, Agnello, Park and Fleming, taken together.

Meikle (WO 96/17104) teaches forming nitride barrier over insulator including in contact via or in storage capacitor or in gate structure. wherein the barrier is formed including refractory metal by CVD. See page 2 line 20 to page 6 line 11. The use of source gases such as WF₆, various silanes, ammonia, substrate heating, etc. is also shown.

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Agnello teaches forming multilayer structure comprising polysilicon layer, barrier refractory metal-silicon-nitrogen intervening layer, upper conductor layer thereon including refractory metal such as W. The use of TaSiN and the replacement of W for Ta is also taught. The use of such barrier in various multilayer structure is also taught. See column 3 line 38 to column 4 line 27, column 5 lines 10-17, line 56 to column 6 line 28.

The references do not recite the vacuuming conditions.

Park teaches the use of CVD to form barrier such as WN. Conventional tungsten and nitrogen sources and reduction gases, e.g., NH₃, WF₆, H₂, and parameters, including vacuum condition and wafer heating, are also taught. The application of the barrier nitride 42 in contact hole 38 in interlayer insulator 36 prior to forming metal 44 filling the contact hole is also shown. See column 2 line 45 to column 3 line 50.

Fleming teaches the use of CVD to form tungsten nitride compounds for diffusion barrier. See the abstract, column 4 line 21 to column 5 line 61. The use of conventional precursor and silicon precursor for forming WSiN barrier is also shown, column 6 line 6-39; the selection of appropriate composition for desired barrier characteristics would have been a matter of routine experimentation and optimization and as shown in Fleming, Figs. 1, 4, 5, and 9 and Agnello, column 3 line 47 to column 5 line 1, column 6 line 6 to column 8 line 3 evidencing the routine experimentation and optimization for forming varying composition to optimize resistance, diffusion barrier characteristics and stability, including the use of conventional tungsten, silicide and nitrogen sources or precursors such as WF₆, SiH₄, SiH₆, NH₃, wafer heating, vacuum condition, etc.

It would have been obvious to one skilled in the art in practicing the above process to have employed appropriate conditions for CVD to form desired barrier in question including the vacuuming since such is conventional and advantageous to form the barrier material having improved step coverage as evidenced by Park and Fleming. It would have been obvious and would have been within the purview of one skilled in the art to have selected the desired processing parameters and desired barrier thickness, appropriate heating and vacuum wherein such would reduce effect of any residue since such optimization is normally within the purview of one skilled in the art and would have been a matter of routine experimentation and would have been conventional and obvious as evidenced by the parameters shown. It would have been conventional and obvious to have employed such barrier in conventional semiconductor structures such as barrier layer in contact structure in interlayer insulator or as barrier in gate structure since such use is well known and as evidenced by the prior art delineated above. The use of conventional alternative conductive materials shown, tungsten or silicon or nitrogen precursors is well within the purview of one skilled in the art to have substituted conventional and suitable alternative materials and as acknowledged in the instant specification, page 18, lines 16-21. Alternatively, official notice is taken regarding the substitution of such conventional and suitable alternative materials and precursors.

Claims 87-106 insofar as in compliance with 35 U.S.C. 112, are rejected under 35 U.S.C. 103(a) as being unpatentable over Meikle, Agnello, Park, Fleming, and further in view of Lee.

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The references are applied as delineated above and do not recite the alternative two-step process of formation the nitride barrier by nitriding the deposited metal.

Lee teaches forming the barrier nitride by depositing the tungsten containing using CVD followed by plasma treatment deposited tungsten containing layer including tungsten silicide layer deposited by CVD. The advantages include improved barrier characteristics, reduced processing time and peeling. See column 3 line 11 to column 4 line 3.

Accordingly, it would have been obvious to one skilled in the art to have employed the alternative processes of depositing the nitride layer directly or of nitriding the deposited layer containing refractory metal since they correspond to known alternatives to form conventional barrier materials. It would have been obvious and would have been within the purview of one skilled in the art to have employed conventional processing, high frequency power during plasma generation, conventional parameters, vacuum, purging, etc., to reduce contamination or residues well within the purview of one skilled in the art. The use of various alternative precursors including WF₆, various silanes, etc., various nitrogen sources such as nitrogen, ammonia or other conventional nitrogen sources are well-known in the art and as such would have been obvious.


Applicant cannot rely upon the foreign priority papers to overcome this rejection because a translation of said papers has not been made of record in accordance with 37 CFR 1.55. See MPEP § 201.15.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to examiner Quach whose telephone number is 703-308-1096. The examiner can normally be reached on M - F from 9 to 5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor Wael Fahmy can be reached on (703) 308-4918. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9318 (Before Final) and (703) 872-9319 (After Final).

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.


Tuan Quach
Primary Examiner